TT 7: Postersession Matter at Low Temperature: Materials

Time: Monday 13:00–16:45 Location: P1B

TT 7.1 Mon 13:00 P1B

The effect of temperature and magnetic field on the diffusion of positrons in slightly deformed copper — •Vera Koos, Matz Haaks, Torsten E.M. Staab, and Peter Herzog — Helmholtz-Institut für Strahlen- und Kernphysik, Nußallee 14-16, D-53115 Bonn

The density of lattice defects like dislocations and vacancies can be measured by positron annihilation spectroscopy (PAS) with outstanding sensitivity. This is due to the fact that positrons diffuse through the lattice and can be trapped by open volumes. Diffusion and trapping are temperature dependent. Additionally the diffusion is influenced by magnetic fields forcing the positrons on curved trajectories perpendicular to the fields direction. In slightly deformed metals changes in the diffusion are reflected by changes of the positron annihilation parameters (S-parameter).

In this study we present PAS results on slightly deformed copper over a temperature range from room temperature (300 K) down to 20 mK, using a ^{3}He/^{4}He dilution refrigerator. By comparison with the predictions of an adapted trapping model it could be shown that dislocations change their behavior from a shallow to a deep positron trap at about 100 K. Below trapping in prismatic dislocation loops plays a significant role.

At several temperatures the effect of a magnetic field (0 to 2 Tesla) was studied. Increase of the field causes a decrease in the S-parameter. Within the scope of the trapping model this can be explained by a decrease of the volume scanned by the positron during its diffusive motion.

TT 7.2 Mon 13:00 P1B

Interacting nuclear dipoles of particles involved in atomic tunnelling processes influence the amplitude of polarisation echoes in glassy glycerol — •Gudrun Fickenscher, Masoomeh Bazrafshan, Kathrin Reinhold, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, Germany

In recent years, an unexpected magnetic field effect of the dielectric properties of non-magnetic glasses was discovered, that cannot be described by the otherwise widely accepted standard tunnelling model. It has since been proven, that it is caused by nuclear electric quadrupole moments of the tunnelling entities interacting with local electric field gradients which change their direction as the particle tunnels from one well to the other. Due to its anisotropic nature the interaction of nuclear magnetic dipole moments leads to an analogous effect on a smaller energy scale. We have studied this effect by measuring the dielectric 2-pulse polarisation echo amplitude of various partially deuterated glycerol samples as a function of the delay time and the magnetic field. Numerical calculations were performed assuming particular tunnelling motions as well as different numbers of dipole moments on the tunnelling entity and in its surrounding. With reasonable parameters these calculations fit the data satisfactorily both qualitatively and quantitatively, giving deeper insight into the motion of tunnelling systems in glassy glycerol.

TT 7.3 Mon 13:00 P1B

Low-temperature investigation of the thermal conductivity of bulk metallic glasses — •Daniel Rotfhuss, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, 69120 Heidelberg, Germany

The thermal conductivity of glasses at temperatures below 1 Kelvin is generally described by the diffusion of thermal phonons. The mean free path of the phonons is limited by scattering processes between the heat-carrying phonons and the tunneling systems in the glasses. We investigate metallic glasses where the thermal transport is due to both phonons an electrons. In superconducting metallic glasses far below T_c the phonons are dominating the conduction of heat. For the first time measurements of thermal conductivity were performed on a bulk metallic glass down to 6 mK. For this purpose we used a SQUID-based contact-free technique because of its extremly small parasitic heating. Results of amorphous $Zr_{52.2}Ti_5Cu_{17.9}Ni_{14.6}Al_{10}$ in the superconduting state are presented which show that the thermal conductivity of the sample scales nearly quadratically in temperature. This suggests that well below T_c the heat transport of superconduting metallic glasses can be described by resonant scattering of phonons by tunneling systems just as in dielectric glasses.

TT 7.4 Mon 13:00 P1B

New Methode to Determine the Specific Heat of Glasses at Ultra-low Temperatures — •Angela Halfar, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, D-69120 Heidelberg

The low temperature properties of glasses are governed by atomic tunneling systems. Due to the structural disorder of glasses the parameters of these atomic tunneling systems are widely distributed. This is the origin of the linear specific heat of glasses at low temperatures, which is a characteristic property of amorphous materials independent of their chemical composition. Measurements of the specific heat of dielectric glasses at ultra-low temperatures are very difficult since even small parasitic heat inputs lead to large systematic errors. To minimize such parasitic heat inputs and to minimize the addenda we have developed a contact-free methode to investigate the specific heat of insulating glasses. It is based on an optical heating system and uses the temperature dependence of the amplitude of polarisation echos as an intrisic thermometer. We shall discuss this new technique and will show first experimental results.

TT 7.5 Mon 13:00 P1B

Antiferromagnetic resonance in multiferroic $YMnO_3$ and $LuMnO_3$ — •D. Kamensky, M. Ozerov, E. Čižmár, J. Wosnitza, and S. Zvyagin — Dresden High Magnetic Field Laboratory (HLD), Forschungszentrum Dresden - Rossendorf, 01314 Dresden, Germany

Multiferroic rare-earth manganites have attracted much attention because of the coexistence of ferroelectric and magnetic order. Combining conventional far-infrared Fourier-transform and THz-range free electron laser electron spin resonance (ESR) techniques, magnetic excitations in the hexagonal multiferroic materials $YMnO_3$ and $LuMnO_3$ have been studied. In the antiferromagnetically (AFM) ordered phase the gap in the excitation spectrum (~ 42 and ~ 48 cm^{-1} for $YMnO_3$ and $LuMnO_3$, respectively) was observed directly. Similar slope of the frequency-field dependences of the AFM resonance modes, ~ 0.5 cm^{-1}/T, was found for both compounds. A fine structure of the AFM resonance absorption has been revealed by means of high-resolution ESR techniques, which can be explained taking into account a finite interaction between the neighboring Mn^{3+} layers.

The work was done in collaboration with A.K. Kolezhuk, D. Smirnov, H.D. Zhou, and C.R. Wiebe.